Transl Neurosci. 2012 Jun 1;3(2):170-180.

Repetitive Transcranial Magnetic Stimulation (rTMS) Modulates Event-Related Potential (ERP) Indices of Attention in Autism.

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Author information

Abstract

Individuals with autism spectrum disorder (ASD) have previously been shown to have significantly augmented and prolonged event-related potentials (ERP) to irrelevant visual stimuli compared to controls at both early and later stages (e.g., N200, P300) of visual processing and evidence of an overall lack of stimulus discrimination. Abnormally large and indiscriminative cortical responses to sensory stimuli may reflect cortical inhibitory deficits and a disruption in the excitation/inhibition ratio. Low-frequency (≤1HZ) repetitive transcranial magnetic stimulation (rTMS) has been shown to increase inhibition of stimulated cortex by the activation of inhibitory circuits. It was our prediction that after 12 sessions of low-frequency rTMS applied bilaterally to the dorsolateral prefrontal cortices in individuals with ASD there would be a significant improvement in ERP indices of selective attention evoked at later (i.e., 200-600 ms) stages of attentional processing as well as an improvement in motor response error rate. We assessed 25 participants with ASD in a task of selective attention using illusory figures before and after 12 sessions of rTMS in a controlled design where a waiting-list group of 20 children with ASD performed the same task twice. We found a significant improvement in both N200 and P300 components as a result of rTMS as well as a significant reduction in response errors. We also found significant reductions in both repetitive behavior and irritability according to clinical behavioral questionnaires as a result of rTMS. We propose that rTMS has the potential to become an important therapeutic tool in ASD research and treatment.

KEYWORDS: Attention; Autism; Event-related potentials; Perception; TMS

PMID: 24683490 PMCID: PMC3966618 DOI: 10.2478/s13380-012-0022-0

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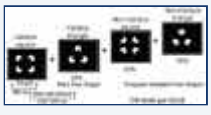
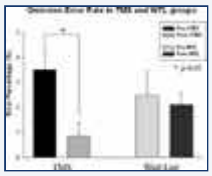
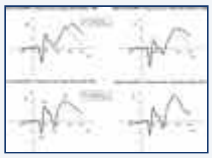
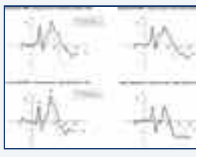

Behav Sci (Basel). 2017 Sep 17;7(3). pii: E63. doi: 10.3390/bs7030063.

Non-Invasive Brain Stimulation for Children with Autism Spectrum Disorders: A Short-Term Outcome Study.

Gómez L[1,2], Vidal B[3], Maragoto C[4,5], Morales LM[6], Berrillo S[7], Vera Cuesta H[8,9], Baez M[10], Denis M[11,12], Marín T[13,14], Cabrera Y[15,16], Sánchez A[17], Alarcón C[18], Selguera M[19], Llanez Y[20], Dieguez L[21], Robinson M[22].

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Abstract

Non-Invasive Brain Stimulation (NIBS) is a relatively new therapeutic approach that has shown beneficial effects in **Autism** Spectrum **Disorder** (ASD). One question to be answered is how enduring its neuromodulatory effect could be. Twenty-four patients with ASD (mean age: 12.2 years) received 20 sessions of NIBS over the left dorsolateral prefrontal cortex (L-DLPFC). They were randomized into two groups with two (G1) or three (G2) clinical evaluations before NIBS. Both groups had a complete follow-up at six months after the intervention, with the aim of determining the short-term outcome using the total score on the **Autism** Behavior Checklist, **Autism** Treatment Evaluation Checklist, and the **Autism** Diagnostic Interview. Transcranial Direct Current Stimulation (tDCS) was used in ASD patients aged <11 years, and repetitive **Transcranial Magnetic Stimulation** (rTMS) for 11-13-year-olds. Observation points were at one, three, and six months after completing all the sessions of NIBS. A significant reduction in the total score on the three clinical scales was observed and maintained during the first six months after treatment, with a slight and non-significant tendency to increase the scores in the last evaluation. Twenty sessions of NIBS over the L-DLPFC improves **autistic** symptoms in ASD children, with a lasting effect of six months.

KEYWORDS: autism; repetitive **transcranial magnetic stimulation**; transcranial direct current stimulation

PMID: 28926975 PMCID: PMC5618071 DOI: 10.3390/bs7030063

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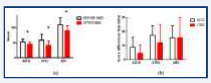
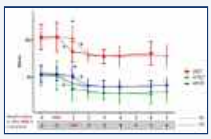

Appl Psychophysiol Biofeedback. 2010 Jun;35(2):147-61. doi: 10.1007/s10484-009-9

Low-frequency repetitive transcranial magnetic stimulation (rTMS) affects event-related potential measures of novelty processing in autism.

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Author information

Abstract

In our previous study on individuals with **autism** spectrum **disorder** (ASD) (Sokhadze et al., Appl Psychophysiol Biofeedback 34:37-51, 2009a) we reported abnormalities in the attention-orienting frontal event-related potentials (ERP) and the sustained-attention centro-parietal ERPs in a visual oddball experiment. These results suggest that individuals with **autism** over-process information needed for the successful differentiation of target and novel stimuli. In the present study we examine the effects of low-frequency, repetitive **Transcranial Magnetic Stimulation** (rTMS) on novelty processing as well as behavior and social functioning in 13 individuals with ASD. Our hypothesis was that low-frequency rTMS application to dorsolateral prefrontal cortex (DLFPC) would result in an alteration of the cortical excitatory/inhibitory balance through the activation of inhibitory GABAergic double bouquet interneurons. We expected to find post-TMS differences in amplitude and latency of early and late ERP components. The results of our current study validate the use of low-frequency rTMS as a modulatory tool that altered the disrupted ratio of cortical excitation to inhibition in **autism**. After rTMS the parieto-occipital P50 amplitude decreased to novel distracters but not to targets; also the amplitude and latency to targets increased for the frontal P50 while decreasing to non-target stimuli. Low-frequency rTMS minimized early cortical responses to irrelevant stimuli and increased responses to relevant stimuli. Improved selectivity in early cortical responses lead to better stimulus differentiation at later-stage responses as was made evident by our P3b and P3a component findings. These results indicate a significant change in early, middle-latency and late ERP components at the frontal, centro-parietal, and parieto-occipital regions of interest in response to target and distracter stimuli as a result of rTMS treatment. Overall, our preliminary results show that rTMS may prove to be an important research tool or treatment modality in addressing the stimulus hypersensitivity characteristic of **autism** spectrum disorders.

PMID: 19941058 PMCID: PMC2876218 DOI: 10.1007/s10484-009-9121-2

[Indexed for MEDLINE] Free PMC Article

Appl Psychophysiol Biofeedback. 2012 Jun;37(2):91-102. doi: 10.1007/s10484-012-9182-5.

Prefrontal neuromodulation using rTMS improves error monitoring and correction function in autism.

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Author information

Abstract

One important executive function known to be compromised in **autism** spectrum **disorder** (ASD) is related to response error monitoring and post-error response correction. Several reports indicate that children with ASD show reduced error processing and deficient behavioral correction after an error is committed. Error sensitivity can be readily examined by measuring event-related potentials (ERP) associated with responses to errors, the fronto-central error-related negativity (ERN), and the error-related positivity (Pe). The goal of our study was to investigate whether reaction time (RT), error rate, post-error RT change, ERN, and Pe will show positive changes following 12-week long slow frequency repetitive TMS (rTMS) over dorsolateral prefrontal cortex (DLPFC) in high functioning children with ASD. We hypothesized that 12 sessions of 1 Hz rTMS bilaterally applied over the DLPFC will result in improvements reflected in both behavioral and ERP measures. Participants were randomly assigned to either active rTMS treatment or wait-list (WTL) groups. Baseline and post-TMS/or WTL EEG was collected using 128 channel EEG system. The task involved the recognition of a specific illusory shape, in this case a square or triangle, created by three or four inducer disks. ERN in TMS treatment group became significantly more negative. The number of omission errors decreased post-TMS. The RT did not change, but post-error RT became slower. There were no changes in RT, error rate, post-error RT slowing, nor in ERN/Pe measures in the wait-list group. Our results show significant post-TMS differences in the response-locked ERP such as ERN, as well as behavioral response monitoring measures indicative of improved error monitoring and correction function. The ERN and Pe, along with behavioral performance measures, can be used as functional outcome measures to assess the effectiveness of neuromodulation (e.g., rTMS) in children with **autism** and thus may have important practical implications.

PMID: 22311204 DOI: 10.1007/s10484-012-9182-5

[Indexed for MEDLINE]